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NATURAL GAS, AN ECONOMICAL ALTERNATIVE TRANSPORTATION FUEL

The Facts ...

Fuel purchases are a major operating cost for commercial vehicle fleet operators and private vehicle owners. With gasoline prices unpredictable these days, a significant reduction in operating cost can be achieved if vehicles are converted to run on an alternative fuel such as natural gas.

Converting from gasoline to natural gas can save up to 50 per cent on vehicle fuel bills, add to the vehicle engine life and reduce emissions.

The use of natural gas as a transportation fuel is not new. It has been used as a transportation fuel for 60 years in many countries. Natural gas, comprised primarily of methane, has an octane rating of 130 compared to about 92 for premium gasoline. Octane rating indicates the antiknock quality and is a measure of resistance of fuel to premature ignition. In terms of volume one cubic metre of natural gas at atmospheric pressure is equivalent to one litre of gasoline on an energy basis.

Natural gas is an economical, safe and clean-burning transportation fuel. It dissipates quickly if released in the air making it safer than propane. Natural gas fuel is non-toxic and lighter than air with a high ignition point. It can reduce air pollution from tail pipe emissions. A vehicle running on natural gas can produce about 70 per cent less pollutants than one running on gasoline.

Natural gas costs 40 to 70 per cent less than gasoline, 30 to 50 per cent less than diesel and 20 to 30 per cent less than propane (Information source: Alternate Fuel Information Package; Northwestern Utilities, Canadian Western Natural Gas) depending on fuel consumption and sources.

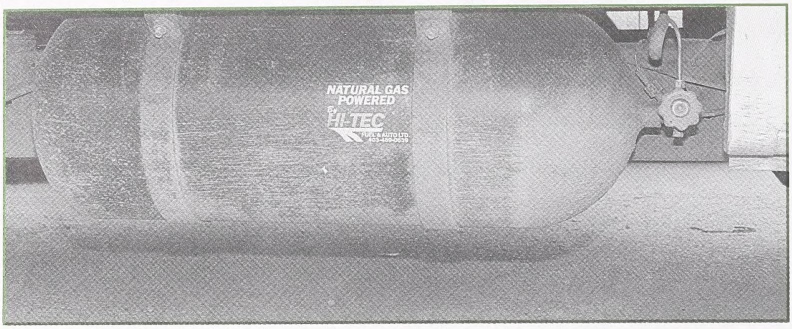
There is an abundant supply of natural gas in Alberta. It is distributed by pipeline throughout most of the province to almost every home or building. In many cases vehicles can be conveniently refuelled at these buildings using a vehicle refuelling appliance (VRA). This allows natural gas vehicles to be readily fuelled without large central refuelling facilities and can improve vehicle productivity as they are refuelled at night and ready to travel every morning.

Central Delivery and Courier Services of Alberta Public Works, Supply and Services Edmonton

Natural gas is normally compressed to 20 MPa (3,000 p.s.i.) into cylinders in order to make it useable as a fuel for vehicles. Storage cylinders made of high strength steel or aluminium or wound carbon composite fibre are used. Each of these cylinders can hold the equivalent of eight to 30 litres of gasoline.

Conversion of a vehicle to natural gas from gasoline requires no internal modifications to the engine. It is possible to run the vehicle on either fuel at the turn of a fuel selector switch mounted on the dashboard. There is also a significant increase in the driving range of the vehicle with the addition of natural gas to the fuel system.

Conversion kits usually include a fuel gauge, refuelling connector, storage cylinders, master shut-off valve, selector switch, electronic spark control, stainless steel fuel lines, pressure regulators, and solenoid valves to control flow of fuels to the engine. The pressure regulator reduces the pressure of the gas in the storage cylinders to atmospheric pressure and then delivers it to the air/fuel mixer. A safety feature such as a vacuum shut-off valve, which stops the flow of gas to the engine when the en-



NGV Fuel Cylinder mounted to the chassis of converted courier service vehicle.

gine is not running, is also installed.

Once a vehicle is converted to natural gas it can be refuelled using two different methods: the fast-fill method and the time-fill method. Fast-filling takes about three to five minutes and time-filling takes several hours for each vehicle. Fast-filling is normally done at fuelling stations. The time-fill method is often used by large fleet operators to fill several vehicles overnight. Time-filling requires a vehicle refuelling appliance (VRA), which connects to the gas line and refuels a natural gas vehicle overnight.

The VRA costs approximately $49 a month to rent and as such vehicles must consume at least 4,500 litres of gasoline annually to make the use of VRA economical.

There are currently six public natural gas fast-fill refuelling stations in Alberta, three in Edmonton and one each in Calgary, Brooks and Medicine Hat. Nine Alberta companies each have their own private fast-fill refuelling stations.

The cost of conversion is decreasing with improvements in technology. For example, light-weight full composite compressed natural gas (CNG) storage cylinders are now available. They are about one-quarter the weight of commonly used high strength steel CNG cylinders. Less weight translates into higher efficiency and lower fuel usage and more cylinders can be installed to increase the driving range of the vehicle.

Converting a vehicle to natural gas costs from $2,500 to $3,600. There is currently a $500 government grant available for each conversion, and, in some cases (under certain conditions), an additional $500 industry development grant is also available. These grants are available only if the application for the grant is made through local utility companies. The net conversion cost may be as low as $1,500 to $2,600. Major utilities also have cylinder rental programs which can further reduce the capital cost outlay.

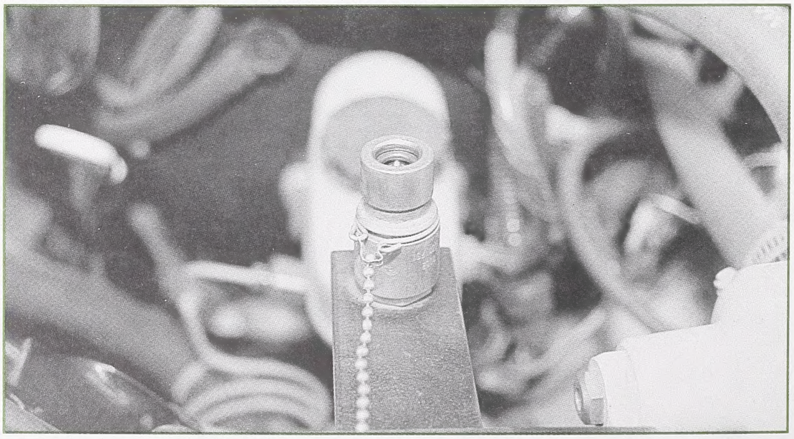
The Application ...

The Central Delivery and Courier Services of Alberta Public Works, Supply and Services has a fleet of vans and trucks for pickup and delivery of mail to and from various government departments. In June 1991, the energy audit team of the Energy Efficiency Branch conducted a transportation energy audit to help Courier Services identify areas of potential savings in order to reduce operating costs.

The audit team suggested several ways to reduce the fleet operating cost. Converting vehicles to natural gas was one of those suggestions. Following the energy audit several of their 3/4-ton and one-ton delivery vans and a mini-van were converted.

Four vehicles in Edmonton, two vehicles in Calgary and one in Medicine Hat were converted to run on natural gas. All are equipped with a duel fuel system and can run on either gasoline or natural gas. In Edmonton and Medicine Hat refuelling is done by the fast-fill method at local refuelling stations. In Calgary, rented VRAs are used.

Conversions were done by local firms approved by the gas utilities. There were some initial problems but the conversions were successful. Conversion costs varied for each vehicle. The average cost was approximately $2,690 for each vehicle including grants. The con-



Refuelling Connector

versions were done in late June and early July of 1991.

The cost of operating these vehicles on gasoline was about $0.18 per kilometre. Running them on natural gas now costs $0.09 per kilometre. Assuming an average of 12,000 kilometers per vehicle per year the annual savings and payback for each vehicle are calculated as follows:

Operating costs:

Gasoline only:
12,000 km x $0.18 per km = $2,160

Dual-fuel (natural gas, gasoline):
12,000 km x $0.09 per km = $1,080

Annual savings for each vehicle
$2,160 - $1,080 = $1,080

The payback period is calculated by dividing capital cost by net savings. With the annual savings of $1,080 the payback period is about 2.5 years:

$$\frac{\$2690}{\$1080} \times 12 \text{ months} = 29.9 \text{ months or } 2.5 \text{ years}$$

For Central Delivery and Courier Services this was a good investment. Payback, depending upon the daily distance travelled and fuel efficiency of the vehicle, can be attractive.

The Bottom Line ...

It is clear from the experience of the Central Delivery and Courier Services that the use of natural gas as an alternative fuel has many benefits. Not only is it a safe and a clean fuel, but it results in reduced maintenance and repair costs and fuel cost savings.

Commercial fleet owners, managers and private vehicle owners can estimate potential annual savings using Figure 1. Figure 1 shows the potential annual savings (based on the distance driven by the vehicle) through the use of natural gas rather than gasoline. Savings are based on an equivalent price difference of $0.22 per litre between gasoline and natural gas.

To use the graph, first convert fuel consumption to L/100 km if it is in mpg. Simply divide 282.5 by mpg to compute L/100 km fuel consumption. Then locate the calculated fuel consumption on the horizontal axis of the graph. Draw a vertical line up to the distance travelled by the vehicle. Reading across to the left on the vertical scale of graph will give you the annual savings. The green line shows the potential annual savings for the example.

EXAMPLE:

- Convert a gasoline powered vehicle to natural gas.
- Total distance travelled per year is 40,000 km.
- Cost of gasoline is 49.9 cents per litre.
- Cost of natural gas is 32.0 cents per kg.
- Fuel efficiency of vehicle is 12.5 mpg.

1. Convert mpg to L/100 km

$$\frac{282.48}{\text{mpg}} = \text{L/100 km}$$

$$\frac{282.48}{12.5 \text{ mpg}} = 22.6 \text{ L/100 km}$$

2. Using Figure 1 determine the annual fuel cost savings of $2000 per year

3. Adjust for the actual price difference of natural gas and gasoline:

a) The savings calculated above from the graph are based on an equivalent price difference of $0.22 per litre between gasoline and natural gas. An adjustment factor has to be applied to correct for the actual equivalent price difference. Simply multiply the natural gas cost of $0.32 per kg. by the factor of 0.67. (This is necessary to convert the natural gas price from kg to equivalent gasoline litres).

$0.32 per kg x 0.67 = $0.214 per litre

b) Compute the actual price difference between gasoline and natural gas:

$0.499 per litre of gasoline - $0.214 per litre natural gas = $0.285 per litre

4) Determine the adjustment factor for Figure 1: Divide the actual price difference between gasoline and natural gas by the price difference of $0.22 per litre which Figure 1 is based on.

$$\frac{\$0.285 \text{ per litre}}{\$0.220 \text{ per litre}} = 1.29$$

5. To determine actual annual savings multiply the adjustment factor of 1.29 by the annual savings of $2000 per year.

$2,000 per year x 1.29 = $2580 per year savings

6. The payback period can be determined by dividing capital cost of the conversion by the annual savings, multiplied by 12 months.

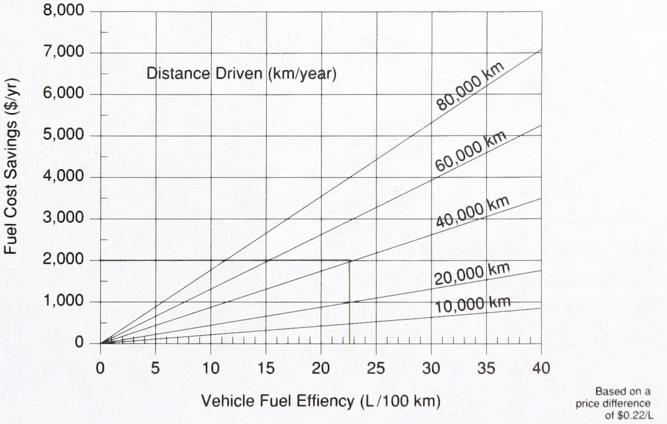
Installation cost = $3,300 (including $500 grant)

Simple payback:

$$\frac{\$3,300}{\$2,580} \times 12 \text{ months} = 15.4 \text{ months or } 1.3 \text{ years}$$

FIGURE 1

Annual Fuel Cost Savings To Convert Gasoline To Natural Gas



SECTOR REVIEW

Savings Potential in the Transportation Sector...

Energy (vehicle fuel) use varies widely, depending on the commercial or industrial activities served by the vehicle fleet.

A transportation energy audit determines initially how much energy is being used and how much it costs in each area. Energy efficiency measures are then identified which may result in energy cost savings.

Energy consumption for transportation is second only to that of industry. Transportation accounts for about 28 per cent of the energy used in Alberta.

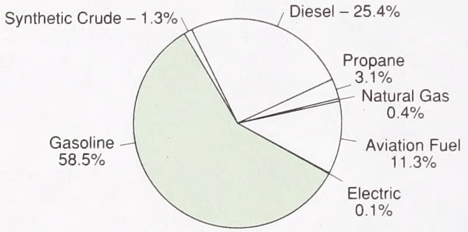
As shown in Figure 2, gasoline comprises 58.5 per cent of fuel use in the transportation sector. This is significant since alternative fuels such as propane, diesel and natural gas are generally less expensive. Many fleets have found it economically attractive to convert vehicles to alternate fuels.

Transportation energy audits of 26 fleets by staff of Alberta's Energy Bus audit program have determined that there is good potential for energy cost savings.

In 10 of the 26 audits, suggestions for conversion from gasoline to an alternative fuel (diesel, natural gas, or propane) indicated a potential savings of 41 per cent of total savings as illustrated in Figure 3. The total energy cost at the 10 companies is about $162,634 annually. Of this amount, Energy Bus staff identified a potential reduction in fuel costs associated with fuel usage of $66,279.

FIGURE 2

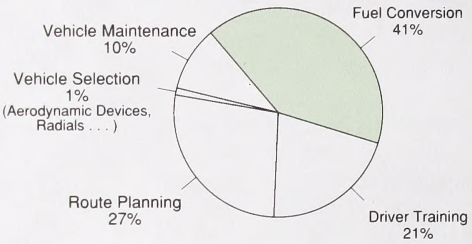
Fuel Use In The Transportation Sector



Source: *ERCB 89A, Energy Requirements in Alberta 1989-2003, Report*, May, 1989 and *A Discussion Paper on the Potential For Reducing CO2 Emission in Alberta* by Energy Efficiency Branch, Alberta Energy

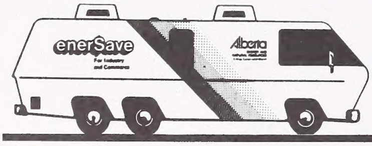
FIGURE 3

Potential Fuel Conversion Savings



FOR MORE INFORMATION

The article *Natural Gas, An Economical Alternative Transportation Fuel* was researched by Jassi Matharoo and the Sector Review completed by David Supruniuk. The Energy Efficiency Branch gratefully acknowledges editorial reviews done by Artur H. Janz, Northwestern Utilities Limited; Ken Belrose and Dale Warunki, Central Delivery and Courier Service; and Dr. David Checkel, University of Alberta.



ENERGY $AVER$

Energy $aver$ is a series of fact sheets about energy efficiency measures that have wide application in Alberta. Each issue highlights a different technology and its successful use in the province. The Sector Review summarizes energy use patterns of different facilities that have used Alberta's Energy Bus audit service. Comments, questions and suggestions are welcome.

Write or phone (collect) to be placed on the mailing list. You may also receive back issue or arrange for an Energy Bus audit (conducted at no charge).

Alberta Department of Energy
Energy Efficiency Branch
7th Floor, North Petroleum Plaza
9945 - 108th Street
Edmonton, Alberta T5K 2G6
Telephone: (403) 427-5200

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